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English Meteorological Periodicities of the Order of a few Decades

By JOSEPH BAXENDELL

I understand that the periodic element in the variations of the annual temperature at Oxford from 1815, to which Miss L. F. Lewis has drawn attention in *Professional Notes* No. 77, as being strongly indicated in her Fig. 5, has occasioned some little surprise and disappointment amongst outside meteorologists, owing to its obvious length [of nearly 40 years] being so much greater than either that of the constantly quoted Brückner period of 35 years, or the frequently suggested shorter one of three times the sunspot cycle, and yet being considerably shorter than the now well-known 52± year periodicity. It may therefore be worth while to review briefly the present state of our knowledge of English meteorological periodicities or quasi-periodicities of the order of a few decades, or at least of the chief of them; the more so because some important implications of Miss Lewis's Fig. 6 appear to have escaped attention.

First place must, I think, be given to the above mentioned cycle of rather more than half a century, indicated so markedly in the late Mr. G. J. Symons's famous diagram of the "Variations of English [annual] Rainfall from 1726", that formed a folding frontispiece to *British Rainfall*, 1891. From an analysis of completely recalculated data (in which additional old records were incorporated), that Dr. J. Glasspoole prepared and published in 1928*, Dr. C. E. P. Brooks and he obtained, as the length of this periodicity,

* *Met. Mag.*, London, 63, 1928, p. 1.

51·7 years*. More recently, Dr. Brooks and Miss Hunt have found it in London wind-direction data, with a length of about 51 years†. Confirmation of the existence of such a meteorological cycle, and evidence of its persistence in the past, for a great many centuries, with a length of between 51 and 53 years, has come from various meteorologists and geologists in the western hemisphere. Also a quarter of a century ago, the late Professor H. H. Turner, F.R.S., stated that among the terms with material amplitudes, which he found from his analysis of sunspot data‡, was one of 52 years.

But before I first publicly mentioned§ this periodic variation of something over 50 years, the late Mr. F. Lees Halliwell, F.R. Met. S., formerly chief assistant at the Fernley Observatory, had helped me to re-calculate completely the annual rainfall values for Mr. Symons' diagram, adopting three suggestions that Symons had made, and one of my own; and on analysing this amended material by a method devised by my father, and later developed and much used by the late Professor Balfour Stewart, my cousin, Charles Baxendell found *two* apparently periodic terms of the order of a few decades, the lengths of which were, approximately, 53 years, and 38½ years. In the course of the analysis of Dr. Glasspoole's later revised English rainfall data, already mentioned, Dr. Brooks independently found also the second of these cycles; he considered its length to be perhaps not more than between 37 and 38 years, but certainly much in excess of Brückner's alleged 34·8 years. He had previously found it, with a length of over 39 years, in his elaborate analysis of Nile-flood data for some 800 years||. Some years before this latter work, however, in a communication¶ to the Royal Meteorological Society, Professor H. H. Turner gave his finally suggested length of the full cycle of his "weather chapters" as 38·8 years, and he had previously** shown, mathematically, that a period of over 38 years suited Brückner's own long list of "cold winters" decidedly better than the latter's 35 years. Turner also found confirmation of the not far from 40 year length of this period in much Greenwich data, in the long Padua rainfall record, and even in the mean sea level at Aberdeen. In the foregoing (and other) ways, Miss Lewis's periodicity of nearly 40 years has very considerable ulterior support; while older English temperature data (for London) reveal a most corroborative earlier maximum, 41 years before her first at Oxford.

We have frequently been told, during recent years, in meteorological books and periodicals, that Francis Bacon affirmed that "in the Low Countries" it was said to have been observed "that

* C. E. P. BROOKS and J. GLASSPOOLE, British Floods and Droughts, p. 188.
† *Met. Mag., London*, 68, 1933, p. 155.

‡ *London, Mon. Not. R. astr. Soc.*, 73, 1913, p. 549.

§ *Southport, Fernley Observatory, Report for 1916*, p. 8.

|| *London, Mem. R. met. Soc.*, 2, No. 12, pp. 13 and 19.

¶ *London, Quart. J. R. met. Soc.*, 42, 1916, p. 168.

** *London, Quart. J. R. met. Soc.*, 41, 1915, p. 323.

every five and thirty years the same kind and suit of years and weather comes about again". But this is only half the story and evidently applies essentially, or at least, primarily, as stated, to certain countries on the other side of the North Sea. When, apparently, Bacon had more fully investigated the matter, probably from English traditions, he altered his view as to the length of the period; for in "A New Edition, corrected" of that notorious little book on the "Shepherd of Banbury's Rules to judge of the Changes of the Weather", a profusely commentative editor of the Shepherd (John Claridge)'s "Rules", remarked that:—"Lord Bacon, that Honour to our Nation and the Age which produced him, informs us, that it was an old Opinion there was a total Revolution of the Weather once in forty years, and wishes it were enquired into". (This "new edition, corrected" of the little book, seems to have been published for one Thomas Hurst, by Edward Chance & Co., of 65, St. Paul's Church-Yard, London, in 1827.)

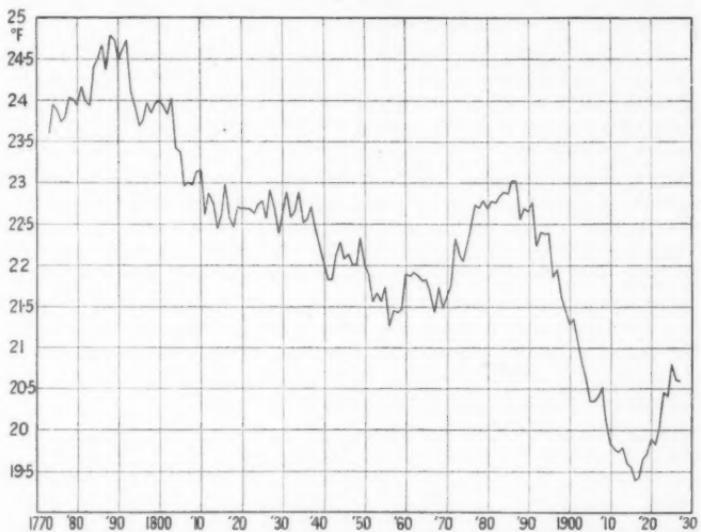


FIG 1.—20-YEAR MOVING AVERAGES OF MEAN SUMMER TEMPERATURE MINUS WINTER TEMPERATURE IN LONDON.

So much for what we may now definitely term the $39 \pm$ year periodicity. But in Miss Lewis's Fig. 6, we are confronted with an entirely different course of affairs. Clearly, the only cycle indicated there is a much longer one—possibly the rainfall and wind direction, etc., term of over half a century. It is obvious that annual mean temperature, and the annual range of mean temperature (or at any rate, the difference between mean winter and mean summer temperatures), are each governed by entirely different laws to the

other, so far as the general major variations of their curves down the decades and centuries are concerned. As it seemed of great interest to ascertain how this winter-summer range curve had been running before the commencement of the Oxford records used by Miss Lewis, I ventured to ask Dr. Brooks to be good enough to prepare a diagram similar to the former's Fig. 6, but based on London data (of which he and I had, years ago, got together an extensive list). This he did, and with his kind permission, the diagram is published here as Fig. 1. It will be seen that it well supports the Oxford one given on page 12 of *Professional Notes* No. 77, and also reveals another and most striking maximum very nearly a century before Miss Lewis's last; and a less marked one occurring not quite half-way between these two. Incidentally, the new longer curve, by its high earlier portion renders increasingly remarkable the great minimum of difference between winter and summer temperature that occurred during the second decade of the present century. (The annual values are running means of 20 years, but they are here plotted to their centering dates.)

A noteworthy indication of the possible importance of the half-century rainfall period is afforded by a diagram for the "Southport" district given in a recent paper on the "Fluctuations of annual rainfall in south Lancashire and north Cheshire", by Mr. D. A. Boyd*, which shows it in a very pronounced form; whilst in his "Neston" curve, representing the Wirral area of Cheshire, its amplitude is greatly reduced, the consequence evidently of that district's lying under the "rain-shadow" of Snowdonia. This seems to indicate clearly that the rains subject to the $52 \pm$ year periodicity consist largely of orographic precipitation of vapour of Atlantic origin, and therefore that the catchments on the high western gathering grounds for the water supplies to several of our largest English cities may be seriously affected by the long, generally drier period upon which, according to all the relevant data in our possession, we are now entering—if, indeed, we have not already entered into it.

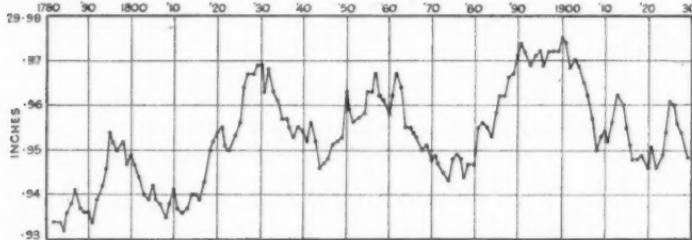


FIG. 2. LONDON AIR PRESSURE, 1774-1936

There remains to be mentioned a cycle of 33 or 34 years. This has long been suggested by various writers, but in this country is, apparently, most pronounced in air pressure, at any rate in

* *London, Quart. J. R. met. Soc.*, 63, 1937, p. 504.

London, where, as will be seen from the accompanying Fig. 2 (the greater part of which Mr. Charles Baxendell computed for me many years ago at the request of Mr. Alex. B. MacDowall—who was searching for Brückner's period), it extends back to the earliest records that Mr. R. C. Mossman and Mr. H. S. Eaton were able to find and to adjust (they hoped) so as to connect to the Greenwich series. The annual values of pressure have been smoothed by forming running means of 17 years and plotting these to their centering dates. A most obvious lesson to be drawn from the curve is that the chief long-period variations of atmospheric pressure have nothing in common with those of either temperature or rainfall—in England. But Dr. Brooks and Miss Hunt have found a 34-year term in London wind-direction*, and Dr. Brooks has shown that a periodicity of between 33 and 34 years is well-marked in the 800 years Nile-flood data mentioned above, while earlier still, E. Huntington and H. L. Moore, in America, had asserted that such a cycle was apparent in the tree-rings of the great Californian *Sequoias*, and in the rainfall of Ohio and elsewhere, respectively. Since the end of the first decade of the present century this old-established periodicity (like several other particularly well-authenticated ones) has shown strange abnormalities. There can be little doubt that the last true minimum and maximum were those shown in the diagram at 1908 and 1925, respectively, and that the anomalous ones seen between these were occasioned by some disturbing influence.

I should, perhaps, add that very accordant indications have been found in the British Isles of a feebler periodicity of $22\frac{1}{2}$ years—the magnetic sunspot cycle, which is so well-developed in the incidence and duration of the winter rains at Adelaide, South Australia, as Mr. E. A. Cornish has recently shown†, and in which Dr. F. J. W. Whipple is particularly interested. I have reason to hope that Dr. C. E. P. Brooks will shortly publish some particulars of its manifestation in our Islands.

[Note by Dr. C. E. P. Brooks]. At Mr. Baxendell's suggestion I add a note about the results of a preliminary study of the long period cycles in the atmospheric circulation over the British Isles. The data are the same as those in the investigation of the 5 year cycle, described in the *Meteorological Magazine* for October, 1937. The pressures and resultant winds at London and Edinburgh and the pressures at Paris cover more than 150 years but even this includes only three or four repetitions of these long cycles, and for the other stations the records are shorter. The material is insufficient to eliminate interferences and irregularities and the results are to that extent uncertain. Phase angles refer to a zero at Jan. 1st, 1937; resultant winds are given in degrees from north through east; they are of course minor fluctuations superposed on the normal prevailing south-west wind.

* *Met. Mag., London*, 68, 1933, p. 155.

† *London, Quart. J. R. met. Soc.*, 62, 1936, p. 481.

The 52 year cycle does not appear consistently in the pressures at Edinburgh, London or Paris. The resultant winds are more consistent, the phase differences between the last two cycles at London and Edinburgh respectively being :— N. component 20° and 37° , E. component 63° and 58° . The resultant directions at multiples of 52 years before Jan. 1937 were : London 98° ; Dublin 98° ; Edinburgh 2° . As the cycle progresses the resultants at London and Dublin swing rapidly through north to west, but the oscillation at Edinburgh is almost entirely confined to the north component. As Mr. Baxendell points out, the 52 year cycle appears prominently in the rainfall of England, but the nature of the association between wind and rainfall is not yet clear.

The 39 year cycle appears fairly regularly in the pressure data for London and Paris, at each of which the phase angles of the last three cycles all fall within a range of 90° ; the maximum pressure appears to come about two years earlier at London than at Paris. At Valentia, Edinburgh and Stykkisholm the pressures do not show this cycle. It does not appear clearly in the resultant winds at London, but the N. component at Edinburgh is consistent over three cycles. The resultant winds at multiples of 39 years before Jan. 1st, 1937 are : London 263° , Dublin 16° , Edinburgh 180° . This is near the maximum of the pressure cycle at London, and it seems probable that the mechanism of the 39 year cycle consists of a rise and fall of pressure over south-east England and northern France, with outwardly directed winds at maximum pressure and inwardly directed winds at minimum pressure.

The 34 year cycle is consistently shown in the pressure at London, where four successive cycles give phase angles (at Jan. 1st, 1937) of 168° , 181° , 199° and 187° respectively; at other stations it is much less regular. On the other hand it is not well shown in the winds of London, but comes out clearly in Edinburgh, where three successive cycles show a range of less than 90° in the phase angles of both north and east components. The nature of this cycle appears to be similar to that of 39 years, namely an oscillation of pressure over eastern England with alternately out-flowing and in-flowing winds at Edinburgh and Dublin, but the details are not yet clear. Unfortunately the data are not sufficient to separate the 34 and 39 year cycles completely, for which about 250 years would be required.

The Climate of the British Isles

It has been remarked that the British Isles have plenty of weather, but little climate. Mr. Bilham's massive book* does not bear out this libel, for he finds much to say about all the usual climatic elements and a few that are less commonly treated. As Super-

* The Climate of the British Isles, being an introductory study of the official records, for students and general readers. By E. G. Bilham. Macmillan & Co., Ltd., London, 1938. Illus. Size 6 in. \times 8½ in. Pp. xix + 374. 21s. net.

intendent of the division of the Meteorological Office which deals with British Climatology and British Rainfall, he is in a unique position to assemble the material for such a purpose, and his book is authoritative to a degree far beyond anything hitherto published for these islands.

The opening chapters are introductory, the first dealing with the scope of climatology and giving some necessary explanations about the methods of deriving values of the different elements, while the second describes the geographical conditions which make for our temperate climate. The third chapter is mainly synoptic, relating the various types of weather to characteristic pressure distributions on the basis of Colonel Gold's classification of weather charts. It is interesting to note that these types, which are presumably selected for their importance as constituents of climate, are named from the intermediate points of the compass—south-west, north-west, etc. (apart from the non-directional cyclonic and anticyclonic), while the older classification of Abercromby, which aims rather at persistence of type, refers to the cardinal points—westerly, southerly, etc. Bilham's classification seems an improvement but one would have liked to see a reference to Abercromby's pioneer work.

With the chapter on "wind" we enter on the real statistical discussion. Figures of direction and force or velocity are given for representative stations, discussed and illustrated both in their geographical distribution and annual variation, and considerable attention is devoted to the subjects of gales and violent gusts, and of land and sea breezes.

Rainfall, as would be expected, is discussed in great detail, and as with wind, attention is not directed solely to average quantities but also to frequencies and extreme values. There is a coloured folding chart of the annual average. The succeeding chapter, "Evaporation and Percolation", describes what happens to the rainfall after it has reached the ground. All this part of the book will be of great value to water engineers.

The chapter on "Temperature of the Air" is based mainly on the observations for the period 1906–1935 but longer records are also utilised, especially that at Oxford. The duration of bright sunshine is next discussed exhaustively. Britain is the home of the Campbell-Stokes sunshine recorder and information about the distribution of sunshine is probably more complete for this country than for any other in the world, a highly satisfactory position in view of the importance of this element for health. Estimates of cloud amount are much less reliable as a substitute and are only briefly discussed. Variations of atmospheric humidity are considered from many aspects, and the various tables and diagrams based on an analysis of the data from the principal observatories satisfy a long-felt want. In Chapter X we have statistics of the frequency of "weather"—ground frost, snow, hail and thunder, with accounts of great snow and hailstorms. Another subject on which system-

atised treatment was badly needed was visibility ("atmospheric obscurity") and here again the need is abundantly met.

The last chapter deals with special types of climate, i.e. coastal compared with inland, the peculiar local climates of narrow valleys, and towns, exemplified by London. Although our "mountains" are not very high, it would have been of interest if the author had given also a section on "hill climates", especially in connexion with winter sports, but high-level stations are frequently referred to in connexion with the individual elements. An appendix gives monthly averages and extremes for 39 stations well distributed over the British Isles.

This inadequate summary will suffice to show that the book is extraordinarily thorough and painstaking. There are no fewer than 101 illustrations and 63 tables (in addition to the climatic summaries in the appendix), and the labour of proof-reading alone, quite apart from the compilation, must have been arduous. Yet the reviewer noticed only one serious error—in Fig. 57. The index occupies 13 pages and is very thorough, but some of the entries might have been sub-divided; for example the entry for Valentia Observatory gives 38 page numbers with no indication of which element is referred to on any one page. The bibliographies at the end of each chapter are generally adequate though not in correct bibliographical form.

Where so much is given, it may seem ungracious to ask for more; but there are two points which call for comment. The first is that solar radiation although frequently mentioned incidentally, is almost ignored as a climatic element apart from simple duration of sunshine. There is only one casual reference to ultra-violet radiation, which is probably the most important single quantity in the medical climatology of these islands. Admittedly the meagre data available would have been difficult to handle, but even to call attention to the deficiency would have been a valuable service. The second comment is that the author writes throughout almost as if the climate of a place is a fixed attribute instead of an abstraction depending on the period of observations. Cyclical variations of long period and secular changes are dismissed in a few words although they are not only of great interest in themselves but quite possibly of real economic importance. The rarity of severe frosts during the present century, for example, is a climatic fact of considerable significance to the householder.

For the "general reader" the book though quite readable seems likely to be somewhat heavy going, but the geographer and anyone else who requires a specialised knowledge of the climate of the British Isles will find it indispensable. The dust jacket is a trifle startling for a scientific work but otherwise the general appearance and binding are up to the high standard expected of the publishers, and all things considered, the price is most moderate.

C. E. P. BROOKS.

OFFICIAL NOTICE

We have been asked by the President of the International Meteorological Committee to publish the following notice :—

Secretariat of the International Meteorological Organization

Applications are invited for the post of Chief of the Secretariat of the International Meteorological Organization, at present located at De Bilt, Holland, but to be transferred to Switzerland.

The functions of the Secretariat as laid down in the Statutes of the Organization are as follows :—

"Un Secrétariat, fonctionnant sous la direction du Président du Comité Météorologique International, est chargé de l'organisation des réunions de la Conférence, du Comité et des Commissions ainsi que de la publication des Procès-verbaux. Il constitue également un centre de documentation relatif aux Services météorologiques du monde entier et il aide, dans toute la mesure de ses moyens, le Président du Comité et les Presidents des Commissions dans l'exécution de leurs travaux."

Applicants must be able to correspond in English, French and German and to speak two of these languages.

The salary will be £550, rising by annual increments of £20 to £750. Superannuation will be based on a commercial insurance policy, the premium of which will be 15 per cent of the salary, 10 per cent being paid by the employer and 5 per cent by the employee.

Appointments will be made on probation for two years and will be terminable by six months notice on either side.

Applications should be sent before May 10th, 1938, to Dr. Th. Hesselberg, President of the International Meteorological Committee, Det Norske Meteorologiske Institutt, Oslo, Norway, from whom further particulars may be obtained on request.

Royal Meteorological Society

The monthly meeting of the Society was held on Wednesday, March 16th, in the Society's rooms at 49, Cromwell Road, South Kensington; Dr. B. A. Keen, F.R.S., President, in the Chair. Mr. F. Entwistle, B.Sc., F.R.Met.S., Head of the Overseas Division of the Meteorological Office, Air Ministry, delivered the Symons Memorial Lecture on the subject of "Atlantic Flight and its bearings on Meteorology" of which the following is an abstract :—

The series of survey flights carried out across the North Atlantic last year by Imperial Airways Ltd. in conjunction with Pan American Airways Inc. aroused considerable public interest largely owing to the fact that, although the flights were of an experimental character, the operations were effected with the smoothness and efficiency of a scheduled air service.

The success of these flights was due in very large measure to the thorough preparations which preceded them and to the ground organization, including radio and meteorological services, which was provided. On the first double flight on the night of July 5th-6th, the times of departure of the two aircraft from Foynes and Botwood were adjusted on the basis of meteorological forecasts so that they should arrive at their respective destinations as nearly as possible at the same time. Actually they arrived within 10 minutes of each other.

The lecturer referred to preliminary investigations which were carried out by the Overseas Division of the Meteorological Office in order to provide essential operational data before the flights commenced. The first investigation, commenced early in 1936, had as its object the determination of the maximum average head wind component that would be experienced on an east to west track along the Great Circle route between Ireland and Newfoundland. The results, which were based on an examination of data covering a period of 10 years, indicated that while the maximum wind speed likely to be encountered at any point was 95 m.p.h., the maximum average speed over the whole route was 60 m.p.h. This average speed, however, occurred only once in ten years and the investigation showed that if, in the operation of a trans-Atlantic aircraft, an allowance was made for a maximum head wind on the east-west track of 40 m.p.h. there would be very few occasions in any one year when it was necessary to cancel the flight.

A more comprehensive investigation followed in which the times of flight of aircraft of different air speeds on alternative trans-Atlantic routes were compared. The results of this investigation confirmed those of the earlier research besides producing additional valuable data. Later investigations were concerned with the meteorological conditions affecting the operation of aircraft in Newfoundland, the variation of wind with altitude over the North Atlantic and the frequency and minimum heights of low cloud.

Reference was also made to the attachment for one year from November 1936 of a technical officer of the Overseas Division of the Meteorological Office to the "Manchester Port", a cargo ship operating between Manchester and Canada. During this period the meteorological officer completed eight round voyages in the course of which he made regular pilot balloon observations to determine the wind speed and direction at different altitudes, constructed daily weather charts from observations received by radio from Europe and North America as well as from ships at sea, and studied in detail the characteristics of the Atlantic disturbances through which the ship passed.

Turning to the actual meteorological organization brought into operation for the flights the lecturer noted that the Meteorological Office, Air Ministry, operates the meteorological service at the Irish base at Foynes on behalf of the Government of Eire on an agency

basis while the Meteorological Service of Canada operates the service at Botwood on behalf of the Newfoundland Government.

The organization involved the preparation of weather charts covering eastern North America, the Atlantic and western Europe at intervals of six hours. Close co-operation was maintained by radio between the meteorological services at Foynes and Botwood, views being exchanged on the development of the meteorological situation. Before a flight commenced the Commander was supplied with a comprehensive weather report, including a detailed forecast of the meteorological conditions likely to be experienced over different parts of the route, and a copy of the latest weather chart on which the forecast was based. This information was supplemented by later advices sent by radio to the aircraft in flight as new information became available.

Approximately half way across the Atlantic the control of the aircraft was transferred from the base of departure to the terminus and the meteorological station at the latter base then took over the supply of information for the remainder of the flight.

A detailed description of the weather conditions experienced during the daylight flight of the "Caledonia" on August 15th was given. It was pointed out that although conditions were far from ideal along the route the flight was completed without incident and the Commander was kept fully informed as to the weather ahead, landing at Botwood in perfect conditions as forecast before he left Foynes.

There followed examples of the research which is being pursued on the meteorology of the North Atlantic. One example included a discussion of the detailed vertical structure of a disturbance through which the "Caledonia" passed on August 20th-21st and illustrated the value of combining information obtained from the aircraft's log with the weather data normally available.

The lecturer, in conclusion, pointed out how these investigations which are essential to the supply of accurate meteorological information for trans-Atlantic flying will benefit meteorological science generally and in particular, the weather forecasting services of the countries of western Europe, the greater part of the weather of these countries developing over and moving from the Atlantic. The development of long distance air routes in various parts of the world is stimulating similar meteorological activity and is providing data for investigation on a scale hitherto unknown.

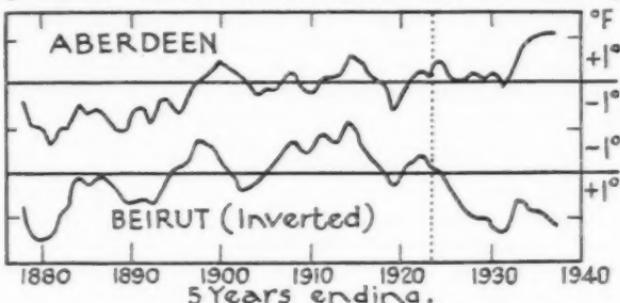
Correspondence
To the Editor, *Meteorological Magazine*

Period Temperature Variations

In the very interesting article on Arctic temperature variations by Dr. Brooks, in the March issue of the *Meteorological Magazine*, it was pointed out that the early 1920's were the critical years during

which the rise of Arctic temperatures commenced. Other meteorological changes can also be related to this period, and a clear example of such is shown by the period temperature variations in Scotland compared with those of the eastern Mediterranean sea.

The following figure compares the five-year moving average of temperature at Aberdeen with the inverted curve for Beirut, Syria.



FIVE-YEAR MOVING DEPARTURES FROM THE MEAN, 1901-30

It will be seen that these curves show close temperature opposition from 1875 to about 1923, but from 1924 to 1937 there has been a great change, and except for the years 1930-3, the opposition has quite died out, the 1930's being abnormally warm at both stations.

The observations at the American University, Beirut, and of course at Aberdeen, appear to be thoroughly reliable, and the reversal of this apparently normal temperature relationship presents an intriguing problem in atmospheric circulation for meteorologists to solve.

G. S. CALLENDAR.

Imperial College of Science, S.W.7, March 30th, 1938.

Lunar Corona

There was a marked corona round the moon at about 2115 G.M.T. on the evening of February 11th. It consisted of the usual aureole, one blue ring about $\frac{1}{2}$ ° wide with a red outer ring, both of which were bright. Two faint outer rings were suspected. The moon was shining through what seemed to be cirrocumulus.

CICELY M. BOTLEY.

Guildables, 17, Holmesdale Gardens, Hastings. February 12th, 1938.

A Green Moon

I observed a green moon at Leuchars, Fife, on the morning of Friday, December 17th, 1937, at a quarter past seven. The moon was 5 degrees above the horizon and 310 degrees from north when the phenomenon first became apparent. The sky was almost cloudless at the time with a trace of stratocumulus cloud, and becoming pale

in the south-east with the early dawn. An olive green light appeared to radiate from the moon and the surface of the moon appeared pale green. Patches of cloud passing across the moon also appeared green and had no effect on the phenomenon. The green moon lasted for a quarter of an hour when it slowly became pale yellow deepening to orange as it sank beneath the horizon. The moon was full at the time and was viewed across the expanse of the aerodrome with snow covered hills to the west.

G. FROUDE.

Meteorological Office, R.A.F., Leuchars, Fife, January 11th, 1938.

"Mother of Pearl" Clouds at Eskdalemuir

The notes in the *Meteorological Magazine* of February, 1938, from Aberdeen and Ross-on-Wye show that the layer of iridescent cloud of January 28th-29th, 1938, was an extensive one. It may be of interest to add a note of the observations at the intermediate station Eskdalemuir.

"Mother of pearl" clouds were seen here between 1700-1710 G.M.T. during a brief interval when the sky was nearly clear of low cloud, twenty minutes after sunset. The colours appeared as alternating bands of green and pink on the under side of a thin sheet of cirriform lenticular cloud in beautifully curved striations like the patterns formed by an oil film on a wet surface. At this time the twilight arch was at an elevation of 20° and the first patch of "mother of pearl" cloud made its appearance some 5° higher than the brightest part of the afterglow and to the left of it, in a darker portion of the sky. The remainder of the cirriform sheet was suffused by a strong yellow glow. Three other smaller patches of "mother of pearl" cloud developed more directly above the brightest part of the afterglow just before the sky was again covered by low cloud.

Surface conditions at 1700. Wind force 7-8, between WSW. and W. by N. Visibility 12 miles.

R. F. M. HAY.

The Observatory, Eskdalemuir, Dumfriesshire, March 15th, 1938.

NOTES AND QUERIES

The Weather of 1937 in the Northern Pennines

Temperatures and other observations have been made for a further year at Moor House (1,840 ft.) in Upper Teesdale; summaries have been given in earlier issues of this Magazine and in the *Quarterly Journal of the Royal Meteorological Society* for 1936. The observations for 1937 are summarised in the following table.

The year was notably dry in comparison with 1935 and 1936, and was generally favourable with the exception of the extremely severe March. The temperatures tell their own story; and it was necessary to make estimates for a number of days on which the

screen was filled with drifting snow. Indeed during one night over three cwt. of snow was driven, despite a well-fitting door, into the hallway of the house. Summer and autumn, on the other hand, were mild and dry until late in November.

	Mean °F.	Mean Max. °F.	Mean Min. °F.	Extremes and Dates.		Rain- fall* in.	Days* of "Snow- Lying."
				°F.	°F.		
Jan. ...	34.8	38.1	31.5	48 (22)	22 (30)	8.00	15
Feb. ...	32.6	35.5	29.7	45 (3)	19 (24)	8.14	19
Mar. ...	28.4	32.4	24.4	38 (29)	13 (22)	5.72	31
April ...	40.4	45.4	35.4	59 (30)	29 (1, 25)	4.26	7
May ...	46.4	53.3	39.5	67 (29)	33 (6, 16)	4.44	—
June ...	49.5	55.6	43.3	67 (10)	33 (2)	4.54	—
July ...	54.4	61.0	47.8	74 (31)	40 (30)	3.52	—
Aug. ...	55.9	64.5	47.3	76 (3)	33 (27)	3.36	—
Sept. ...	48.7	54.4	43.0	65 (7)	33 (19)	4.76	—
Oct. ...	44.0	49.2	38.8	60 (19)	31 (5)	3.08	—
Nov. ...	36.3	39.9	32.7	51 (1, 3)	22 (14, 20)	1.37	8
Dec. ...	30.9	34.5	27.3	45 (1)	11 (? 18)	3.44	26
Year ...	41.9	47.0	36.7	76 (3.viii)	11 (? 18.xii)	54.63	106

* Approximate; the exposed situation makes for difficulties.

Despite the rather large number of days with "snow-lying" the year was probably rather exceptional in that scarcely a shower of snow or sleet occurred between mid-April and mid-November. Estimates for "snow-lying" are difficult to make on hilly ground largely composed of peat-hags and so the figures given must only be regarded as approximate.

During the last three months of the year the writer has obtained approximate records of temperature from a "mountain-top" station 3 miles west of Moos House, near Dun Fell, the second highest summit of the Pennines. The station itself is almost on the ridge, at an altitude of 2,710 ft., and is easily the highest at which a continuous record has yet been attempted in England. It is hoped that the data will be of value in relation to an investigation of the "helm wind"; so far, however, the "helm" has occurred on too few days to justify even preliminary conclusions. The experience gained from such a severely exposed locality, however, may be of interest.

During October and early November the chief troubles arose from persistent complete saturation of thermograph charts, but this was overcome to some degree by using artists' varnish. The trace of the pen, while thin, was quite good. But with the advent of frost over long periods, alternating with thaw and mist, ice formation on and about the bimetallic coils, hindering movement, took place so often that one thermograph was kept running by the ventilator of the observing hut, giving a rough record only, while attempts were made to devise further protection for the thermograph in the

screen. Again, irregular behaviour of the clocks was probably due to ice formation in the teeth of the driving pinion : frequent coating with fine oil did not overcome this. The covering of the instruments by drifting snow was temporarily overcome by arranging cardboard baffles inside the screen. Next, the screen was erected on the roof of the hut, in the hope that a position might be found in which drifting snow would be carried round the screen rather than into it. But more serious troubles developed during December and early January, due to excessive ice-formation and deposition of rime ; e.g. frost-feathers eighteen inches long grew to windward of the screen after two days' exposure to strong SW. wind. The general coating over the sides and roof of the hut and screen was about three inches thick. This ice-deposit completely sealed the screen at times and was so hard that it could only be dislodged by vigorous blows with an ice-axe. Another position for the screen is now being tried, with reasonable success so far. The writer is considering whether a type of screen with much larger louvres and a hinged base might not be better for such a locality, despite the fact that Stevenson screens have been used effectively in high latitudes. The bimetallic thermographs have been replaced by a mercury-in-steel type, which the writer was fortunate enough to obtain at short notice, and which is working well.

The experience as a whole has been rather surprising, inasmuch as the bimetallic thermograph in an ordinary screen at Moor House has given comparatively little trouble over several years. The additional 900 feet of altitude however, with much more frequent mist and even stronger winds, makes an unexpectedly large difference to the conditions of operation. The experience of going to and from the station in all weathers is also of distinct interest. South-westerly winds, in accordance with the location, are very strong near the ridge, but the hut has withstood the gales well, largely because its base is in a small hollow. One recent measurement of force 9 was made, for example, when the average at west coast stations seems to have been about force 7 from SW.

The following figures may be given ; they are of course only approximate :—

Altitude 2,710 ft.

	Mean. °F.	Mean Max. °F.	Mean Min. °F.	Extremes.	
				°F.	°F.
October ...	41·0	44·4	37·7	55 (19)	29 (27)
November ...	33·3	36·0	30·7	48 (5)	21 (13-14)
December ...	28·7	31·5	26·0	43 (24)	16 (? 12)
January ...	32·4	36·0	28·8	43 (23)	23 (27)
February ...	30·6	34·1	27·1	44 (26)	20 (11, 15)
March ...	38·1	41·5	34·7	49 (11)	23 (26)

As might be expected, temperature remains very uniform over long periods, and the apparent daily range is largely an expression of the frequency of irregular fluctuations, notably during the last three weeks of January with persistent and strong westerly winds. Now that a number of experimental difficulties have been overcome it is hoped that a reasonably good record will be forthcoming, which promises to be of interest, for example in comparison with the "free-air" averages from Mildenhall and Aldergrove.

GORDON MANLEY.

Temperatures at Rickmansworth, 1937

At the end of February 1937, it became necessary to close down the climatological station which had been maintained near the bottom of a deep, enclosed valley between Rickmansworth and Chorley Wood, Herts, since May 1929. Through the courtesy of Lieut.-Comdr. R. F. Sheppard, R.N., a Stevenson screen, containing maximum and minimum thermometers and a thermograph, was set up in his grounds within 50 yards of the site of the existing station and at approximately the same elevation (182 ft.) above sea level, in November 1936. Over the period of 3½ months during which the old and new stations were at work together the differences of temperature between them seldom exceeded 1° F. The general agreement was such as to justify the assumption that thermal conditions at the two sites are almost identical, and the records kept by Lieut.-Comdr. Sheppard since March 1937, may thus fairly be regarded as a continuation of the original series.

Month.	Mean values.			Extremes.			
	Max. A °F.	Min. B °F.	A + B 2 °F.	Max. °F.	Date.	Min. °F.	Date.
Jan. ...	46.7	31.5	39.1	53	6, 23	18	20
Feb. ...	48.5	32.5	40.5	55	4, 15	20	12
Mar. ...	45.2	28.5	36.9	57	20	16	10
Apr. ...	56.6	38.7	47.7	63	6	22	1
May ...	64.3	40.5	52.4	83	29	27	6
June ...	69.3	41.3	55.3	83	11	31	30
July ...	71.1	48.5	59.8	86	3	35	8
Aug. ...	75.4	47.9	61.7	91	6	36	16
Sept. ...	65.7	40.2	52.9	82	7	26	21
Oct. ...	59.7	38.6	49.1	67	1	26	16
Nov. ...	46.5	29.4	37.9	58	2	13	21
Dec. ...	41.2	28.1	34.7	53	22, 23	15	6, 19
Year ...	57.5	37.1	47.3	91	Aug. 6	13	Nov. 21

As the climate of this Hertfordshire valley is one of the most

notably "continental" yet discovered in England, and as the Rickmansworth returns did not appear in the *Monthly Weather Report* after February, a summary of the temperature data for 1937 may be of interest here. In the above table the mean values for each of the ten months March to December are derived from the thermograph charts, while the extremes are from the standard maximum and minimum thermometers throughout the year.

For the sixth year in succession the mean diurnal range of temperature exceeded 20° F. The variations in this figure have been curious: there was a regular increase from 18.9° F. in 1930 to 22.7° F. in 1934, followed by an equally regular decrease to 20.4° F. in 1937. The greatest individual range last year was one of 43° F., from 39° F. to 82° F., on June 6. On June 30 the latest "spring" frost yet recorded at the station was registered, the minimum in the screen being 31° F. A thermometer exposed over grass (which was not always kept so short as it should have been) fell to 6° F. in December, and to 7° F. in March and November.

E. L. HAWKE.

"Such stuff as dreams are made on"

Before 0800 G.M.T. on September 29th, cirrus cloud in a direction 215° from South Farnborough attracted attention by its slow movement: it was white and opaque and seemed at first to be moving very slowly away. At 1000 it seemed to be stationary and at a height, one would say, of about 20,000 ft. judging by its whiteness: a photograph (reproduced as frontispiece to this number) was taken at this time. Later the cloud appeared to be approaching slowly and eventually arrived overhead at 1300 when it appeared as a characteristic tangled web, with blue sky in the interstices, moving slowly from 220°.

An anticyclone was over the Channel at the time and the previous evening cirrus was moving from about 340° at several stations. On the morning in question Biggin Hill reported 80° 10 m.p.h. and later in the day 220° 35 m.p.h. The movement of the cloud under observation during the morning seemed to be about 20 miles in 5 hours.

Fortunately I had been consulted by a pilot as to the weather for a flight to 33,000 ft. to be carried out in the early afternoon and I was able to ask him to observe the substance of this cloud, then overhead, which he would probably penetrate. After the flight I found out that no cloud was reached until about 32,000 ft. and although the cloud was clearly visible from the ground it was invisible while the observer was actually in it. From slightly below and slightly above it appeared as an almost imperceptible film which might easily be ignored: this may account for the scarcity of observations of the nature of cirrus cloud. The pilot put out his hand to feel, if possible, whether ice crystals or the like were present: he felt an extremely fine, dry, powdery dust blowing past his hand. No halo phenomena were observed.

A similar filmy layer was observed at about the same height on another flight in the summer of 1937.

R. M. POULTER.

OBITUARY

We regret to learn of the death on January 21st, at the age of 79, of Dr. Julius Maurer, formerly Director of the Eidgenössische Meteorologische Zentralanstalt of Switzerland.

NEWS IN BRIEF

Prof. B. F. J. Schonland, Professor of Physics of the University of Cape Town, has been elected a Fellow of the Royal Society.

Dr. Rudolph Geiger has been appointed Professor of Physics and Meteorology at the Forstlichen Hochschule, Eberswalde, Germany.

Mr. Alfred Goodwill, who retired from the post of chief observer at the Fernley Observatory, Southport, in January last, had been associated with the work of the Observatory since 1894, when he was appointed deputy observer. During his long period of service under Mr. Joseph Baxendell, Mr. Goodwill gained a high reputation as a skilled observer and computer. At a social gathering of his friends and colleagues on January 17th, Mr. Goodwill was presented with a clock as a token of their esteem. On behalf of the many meteorologists to whom Mr. Goodwill is well known we offer our good wishes in his retirement.

We understand that Miss K. Sprague, Anglefield, Berkhamsted, Herts, wishes to dispose of the meteorological instruments formerly the property of Mr. E. T. Browne, whose death occurred in December last. Any reader who is interested should communicate direct with Miss Sprague.

The Weather of March, 1938

Average pressure for the month was very high over much of western Europe, particularly over southern England and France where it exceeded 1025 mb. In these regions and also in northern Italy and Sardinia pressure was more than 10 mb. above normal. Northwards of this anticyclonic region average pressure diminished, falling below 1000 mb. over Iceland, southern Greenland, northern Scandinavia, Bear Island and Novaya Zemlya. Over these latter regions, also over Russia north of 50°N. and much of northern Canada pressure was 10 mb. below normal. The Siberian winter anticyclone had decreased in intensity, and over Siberia pressure was generally

below normal. Pressure was below normal also over North America.

The anticyclonic weather in western Europe produced abnormally high temperatures; north of about 45°N. in most of Europe, with the exception of Norway, temperatures were 5°–8°F. above normal. Much of the Arctic and of northern Siberia were also abnormally warm; Spitsbergen (13·6°F.) was 9°F. and Matotchkine Char (6°F.) was 8°F. above normal. Temperatures were above normal over most of North America; in the United States east of 100°W. the excesses were between 5° and 10°F., and in a region stretching from south to north in central Canada the excesses were more than 10°F. In the extreme east of Canada, however, the weather was slightly colder than usual.

In Europe precipitation was nearly everywhere deficient except locally in the north, where Stornoway had an excess of 3 in. and the Faeroes an excess of 6 in. In North America, also, precipitation was below the normal in most regions, a notable exception being St. Louis with over 9 in.

The weather of March was abnormally warm, exceptionally dry and very sunny in England. The persistently high day temperatures throughout almost the whole of Great Britain during the month are unparalleled in British weather records. The mean maximum temperatures of 58·3°F. at Kew and 54·7°F. at Aberdeen exceed those of any March since 1870, and Greenwich with a mean maximum temperature of 59·3°F. established a record for a century. Daily maxima of 60°F. and above were unusually frequent. "Absolute drought" prevailed from the 1st over south and east England, the Midlands and east Scotland for a period of 16 to 23 days. At Ross-on-Wye it was unbroken on April 1st after 33 days, the total fall of 0·5 mm. being the lowest for the month since 1859. Sunshine was below normal in the north-western half of the British Isles, but was increasingly above normal south-eastwards, stations in Kent having totals of over 200 hrs. Gales were frequent in Scotland. A ridge of high pressure moved eastwards over the British Isles on the 1st and anticyclonic conditions prevailed until the 14th. Temperatures were low in Scotland and the north on the 1st and some snow fell. Hail fell in Ireland and on the east coast, and Portsmouth reported a gale. Maximum temperatures rose generally to the 5th—in some places as much as 20°F.—and remained above 60°F. in England except in the north-west. Sharp ground frosts occurred at night, grass minima of 16° to 18°F. being recorded in places on the 4th, and there was early fog generally from the 4th to 13th. Good sunshine records of 7 to 10 hrs. daily were obtained in all districts from the 1st to 5th, in England until the 7th, and in the Midlands, the south and east until the 9th, Guernsey recording 10·6 hrs. on the 5th. Gales were reported from Scotland on the 2nd to 5th and on the 9th, when Eskdalemuir experienced a gust of 73 m.p.h. Temperature rose in Scotland to the 11th, Dundee having a maximum of 65°F., but fell in England. The 13th and 14th were very

sunny with 10 hrs. on each day in many places. Rothesay had thunder on the 14th. Depressions moving north-east off the coast of Scotland brought rain to Scotland and Ireland on the 15th, the heaviest fall of the month, 2·01 in., occurring at Tourmakeady, Duimbawn Ho., Co. Mayo. Winds were strong from the south, and gales were reported from Markree on the 18th, and from Scotland on the 15th, 17th and 18th. Slight rain on the south coast broke the drought on the 16th, but good sunshine records were still obtained daily, particularly on the 19th, 22nd and 23rd, Jersey having 11 hrs. on the 23rd. Temperatures were very high in south and east England on the 20th, Norwich recording a maximum of 69° F., and a minimum of 58° F.; and maxima of 66° to 68° F. being general in the east. Shallow depressions moved north-eastwards across the country on the 20th and Scotland and north-west England and Wales had rain, 1·60 in. falling in Anglesey: hail fell in Ireland. Fog was general in the mornings of the 22nd and 23rd when a ridge of high pressure extended across England. Day temperatures remained high but minima were low, Rhayader recording 24° F. in the screen, and 13° F. on the grass on the 23rd. Rain fell heavily in Scotland on the 23rd, 1·63 in. at Fort Augustus, and snow and hail on the 24th and 25th, also in the north of England. There was little or no sunshine in England on the 25th, but Scotland enjoyed 5 to 6 hrs. The 26th-31st were again sunny though temperatures were lower on the 26th and 27th. Sunshine generally exceeded 10 hrs. on the 31st, Ross-on-Wye recording 11·8 hrs. The distribution of bright sunshine for the month was as follows :—

	Diff. from		Diff. from	
	Total (hrs.)	normal (hrs.)	Total (hrs.)	normal (hrs.)
Stornoway	..	55	-54	Chester .. 123 + 9
Aberdeen	..	103	- 6	Ross-on-Wye .. 163 +47
Dublin	98	-17	Falmouth .. 157 +21
Birr Castle	90	-21	Gorleston .. 165 +37
Valentia	86	-30	Kew .. 173 +65
Kew, Temperature, Mean, 49·5, Diff. from average + 5·6.				

Miscellaneous notes on weather abroad from various sources.

Fog was experienced off the Isle of Wight on the 5th. Severe gales were reported from the Lofoten Is. on the 2nd, from Iceland on the 5th, when an entire hamlet was blown away, and from the north-west and west coasts of Norway where much damage was caused to shipping on the 6th. Fog occurred off the Dalmatian coast on the 22nd and 27th, and off the Belgian coast on the 23rd. (*The Times*, March 7th to 28th).

After unusually high temperatures for March, Hong Kong had a brief hailstorm on the 9th for the first time on record. 25 people were killed and 150 injured by a tornado which swept a number of villages in the Dacca district of Bengal on the 15th. (*The Times*, March 10th to 19th).

Torrential rainstorms from February 27th to March 2nd caused

extensive floods in Southern California. Over 200 people are reported dead or missing, and damage to property is estimated at £5,000,000. A tornado which swept southern Missouri and Illinois on the 15th caused the death of 18 persons and much damage to property. Heavy snow fell in the prairie district of Canada on the 22nd, while in the east serious floods followed the rapid melting of snow. Tornadoes caused extensive damage and much loss of life in the Middle Western States on the 30th. (*The Times*, March 4th to April 1st).

Daily Readings at Kew Observatory, March, 1938

Date	Pressure, M.S.L. 13h.	Wind, Dir., Force 13h.	Temp.		Rel. Hum. 13h.	Rain.	Sun.	REMARKS (see vol. 69, 1934, p. 1).
			Min.	Max.				
1	mb.							
1	1022.3	W.3	48	54	54	0.04	6.9	r ₀ -r 0h.-4h., pr 16h.
2	1037.1	WSW.3	33	53	50	—	6.1	x early.
3	1037.8	SW.3	35	58	56	—	9.1	x early, f-F 7h.-8h.
4	1040.3	WSW.2	33	58	63	—	9.8	x early, F 21h.-24h.
5	1037.3	WSW.3	34	60	62	—	7.0	Fe-f 0h.-10h.
6	1032.8	WSW.2	34	59	43	—	8.6	x early, m 9h.
7	1030.7	WSW.1	33	53	77	—	2.9	x early, f all day.
8	1024.0	SW.2	31	60	70	—	5.9	x early, f-F till 10h.
9	1020.9	WSW.3	37	60	62	—	8.6	w early.
10	1025.4	WSW.3	46	58	77	—	0.6	f 21h.
11	1030.9	NNE.2	44	60	70	—	4.8	f till 8h., mw 21h.
12	1036.5	E.3	47	54	64	—	2.1	
13	1033.9	E.2	34	55	57	—	2.2	f-Fe till 8h., m 9h.
14	1024.5	S.3	33	56	33	—	10.5	x early.
15	1024.0	SW.3	35	56	74	—	3.1	f-Fe till 10h.
16	1019.6	SSW.4	45	58	62	—	3.6	
17	1024.5	SW.3	49	54	80	—	0.3	id ₀ 7h.-9h.
18	1025.6	SW.4	45	57	62	—	3.1	id ₀ 7h.-9h.
19	1021.5	SSW.5	41	62	40	—	10.5	x early.
20	1014.0	S.4	41	65	42	—	7.7	
21	1009.3	SSW.4	48	61	61	—	6.4	
22	1016.3	ENE.2	42	61	63	—	5.0	z 9h.
23	1020.4	WNW.1	43	62	73	—	5.9	f 0h.-10h., 20h.-24h.
24	1019.5	WSW.4	34	62	53	—	8.5	f0h.-8h., ir ₀ 21h.-24h.
25	1009.2	SW.3	48	54	90	0.18	0.0	ir ₀ 0h.-18h.
26	1017.7	WNW.4	37	49	49	0.04	7.9	r ₀ -r 21h.-24h.
27	1015.1	W.4	43	57	65	Trace	1.9	r ₀ 0h.-1h., pr ₀ 10h.
28	1024.9	SW.2	48	62	64	—	2.0	
29	1024.0	W.3	45	63	63	—	5.1	
30	1024.6	W.4	49	64	60	—	7.8	w early.
31	1026.2	W.3	49	64	59	—	9.1	
*	1024.9	—	41	58	61	0.26	5.6	* Means or Totals.

General Rainfall for March, 1938

England and Wales	27	per cent of the average 1881-1915.
Scotland ...	97	
Ireland ...	65	
British Isles ...	52	

Rainfall: March, 1938: England and Wales

Co.	STATION.	In.	Per cent of Av.	Co.	STATION.	In.	Per cent of Av.
Lond.	Camden Square.....	.34	19	Leics.	Thornton Reservoir ...	.35	19
Sur.	Reigate, Wray Pk. Rd..	.37	16	"	Belvoir Castle.....	.22	12
Kent.	Tenterden, Ashenden..	.54	25	Rut.	Ridlington .....	.28	16
"	Folkestone, Boro. San..	.71	...	Lincs.	Boston, Skirbeck.....	.25	16
"	Margate, Cliftonville....	.45	28	"	Cranwell Aerodrome...	.27	19
"	Eden'bdg., Falconhurst	.59	24	"	Skegness, Marine Gdns..	.16	10
Sus.	Compton, Compton Ho..	.63	23	"	Louth, Westgate.....	.16	8
"	Patching Farm.....	.50	23	"	Brigg, Wrawby St.....	.23	...
"	Eastbourne, Wil. Sq....	.67	30	Notts.	Mansfield, Carr Bank...	.18	9
Hants.	Ventnor, Roy.Nat.Hos..	.42	20	Derby.	Derby, The Arboretum	.29	16
"	Southampton, East Park	.34	15	"	Buxton, Terrace Slopes	1.55	38
"	Ovington Rectory.....	.28	11	Ches.	Bidston Obsy.....	1.02	54
"	Sherborne St. John.....	.20	9	Lancs.	Manchester, Whit. Pk.	1.09	48
Herts.	Royston, Therfield Rec.	.38	21	"	Stonyhurst College.....	1.78	48
Bucks.	Slough, Upton.....	.25	14	"	Southport, Bedford Pk.	1.03	46
Oxf.	Oxford, Radcliffe.....	.35	21	"	Ulverston, Poaka Beck	2.02	52
N'hant.	Wellingboro, Swanspool	.14	8	"	Lancaster, Greg Osay.	1.37	43
"	Cundale .....	.15	...	"	Blackpool	1.37	58
Beds.	Woburn, Exptl. Farm...	.32	19	Yorks.	Wath-upon-Dearne.....	.19	11
Cam.	Cambridge, Bot. Gdns..	.39	27	"	Wakefield, Clarence Pk.	.32	18
"	March.....	.27	17	"	Oughtershaw Hall.....	3.58	...
Essex.	Chelmsford, County Gdns	.37	21	"	Wetherby, Ribston H.		
"	Lexden Hill House.....	.42	...	"	Hull, Pearson Park.....	.21	12
Suff.	Haughley House.....	.54	...	"	Holme-on-Spalding.....	.24	13
"	Rendlesham Hall.....	.39	23	"	Felixkirk, Mt. St. John.	.23	12
"	Lowestoft Sea. School..	.56	35	"	York, Museum Gdns..	.26	15
"	Bury St. Ed., WestleyH.	.70	37	"	Pickering, Houndgate...	.22	11
Norf.	Wells, Holkham Hall....	.23	14	"	Scarborough.....	.18	10
Wilt.	Porton, W.D. Exp'l. Stn	.21	11	"	Middlebrough.....	.04	3
"	Bishop's Cannings.....	.27	12	"	Baldersdale, Hurry Res.	1.52	49
Dor.	Weymouth, Westham..	.30	15	Durk.	Ushaw College.....	.34	15
"	Beaminster, East St....	.23	8	"	Newcastle, Leazes Pk...	.37	18
"	Shaftesbury, Abbey Ho..	.22	9	"	Bellingham, Highgreen	2.09	71
Devon.	Plymouth, The Hoe....	.31	11	"	Lilburn Tower Gdns....	.74	28
"	Holne, Church Pk. Cott.	.44	8	Cumb.	Carlisle, Scaleby Hall...	1.54	63
"	Teignmouth, Den Gdns..	.25	10	"	Borrowdale, Seathwaite	11.50	110
"	Cullompton .....	.17	6	"	Thirlmere, Dale Head H.	6.83	105
"	Sidmouth, U.D.C.....	.19	...	"	Keswick, High Hill....	3.56	79
"	Barnstaple, N. Dev.Ath	.47	18	"	Ravenglass, The Grove	1.97	64
"	Dartm'r, Cranmere Pool	1.40	...	West.	Lilburn Tower Gdns....	1.94	72
"	Okehampton, Uplands..	.71	17	Mon.	Appleby, Castle Bank...	.03	1
Corn.	Redruth, Trewirgie....	.71	20	Glam.	Abergavenny, Larchf'd	1.84	34
"	Penzance, Morrab Gdns..	.51	16	"	Ystalyfera, Wern Ho...	1.99	...
"	St. Austell, Trevarna...	.47	14	"	Treherbert, Tynywaun.	.59	19
Soms.	Chewtown Mendip.....	.38	11	Carm.	Cardiff, Penylan.....	1.48	37
"	Long Ashton.....	.46	18	Pemb.	Carmarthen, M. & P. Sch.	.47	17
"	Street, Millfield.....	.19	9	"	Pembroke, Stackpole Ct.	1.55	...
Glos.	Blockley .....	.49	...	Rad.	Aberystwyth	1.19	22
"	Cirencester, Gwynfa...	.24	10	Mont.	Birm.W.W.Tyrmynydd		
Here.	Ross-on-Wye.....	.02	1	"	Newtown, Penarth Weir		
Salop.	Church Stretton.....	.37	16	"	Lake Vyrnwy	1.86	43
"	Shifnal, Hatton Grange	.44	24	Flint.	Sealand Aerodrome.....	.70	40
"	Cheswardine Hall.....	.69	33	Mer.	Blaenau Ffestiniog	7.18	92
Worc.	Malvern, Free Library...	.21	11	"	Dolgelley, Bontddu...	3.39	69
"	Ombersley, Holt Lock.	.27	16	Carn.	Llandudno	1.46	72
War.	Alecoster, Ragley Hall...	.33	19	Ang.	Snowdon, L. Llydaw 9.	12.90	...
"	Birmingham, Edgbaston	.44	23	"	Holyhead, Salt Island...	1.45	55
				"	Llwydwy	2.48	...

Rainfall : March, 1938 : Scotland and Ireland

Co.	STATION.	In.	Per cent of Av.	Co.	STATION.	In.	Per cent of Av.
I. Man	Douglas, Boro' Cem....	1.88	63	R&C	Achnashellach	16.58	231
Guern.	St.Peter P't.Grange Rd.	.48	19	"	Stornoway,C.GuardStn.	4.32	111
Wig.	Pt. William, Monreith.	1.11	39	Suth.	Lairg.....	4.72	152
"	New Luce School.....	1.32	37	"	Skerray Borgie.....	3.58	...
Kirk.	Dalry, Glendarroch.....	2.81	62	"	Melvich.....	3.44	121
Dumf.	Dumfries, Crichton R.I.	1.91	68	"	Loch More, Achfary....	16.81	261
"	Eskdalemuir Obs.....	3.86	79	Caith.	Wick	2.11	93
Roxb.	Hawick, Wolfelee.....	1.26	38	Ork.	Deerness	3.07	109
Peeb.	Stobo Castle.....	1.52	52	Shet.	Lerwick Observatory...	3.99	126
Berv.	Marchmont House.....	.74	28	Cork.	Cork, University Coll...	1.52	51
E.Lot.	North Berwick Res....	.41	22	"	Roches Point, C.G. Stn.	1.09	36
Midl.	Edinburgh, Blackfd. H.	.57	29	"	Mallow, Longueville...	1.28	44
Lan.	Auchtyfardle	2.60	51	Kerry.	Valentia Observatory...	2.98	66
Ayr.	Kilmarnock, Kay Park	3.65	...	"	Gearhameen.....	7.60	94
"	Girvan, Pinmore.....	2.41	64	"	Bally McElligott Rec...	1.75	...
"	Glen Afton, Ayr San...	4.22	100	"	Darrynane Abbey.....	2.10	51
Renf.	Glasgow, Queen's Park	3.63	139	Wat.	Waterford, Gortmore...	.80	29
"	Greenock, Prospect H..	6.62	142	Tip.	Nenagh, Castle Lough.	1.85	60
Bute.	Rothesay, Ardencraig...	3.82	106	"	Cashel, Ballinamona...	1.84	68
"	Dougarie Lodge.....	3.89	111	Lim.	Foyne, Coolnames....	2.24	76
Arg.	Loch Sunart, G'dale....	8.15	147	Clare.	Inagh, Mount Callan....	5.48	...
"	Ardgour House.....	23.88	...	Wezf.	Gorey, Courtown Ho...	.87	38
"	Glen Etive.....	25.07	317	Wick.	Rathnew, Clonmannon...	.70	...
"	Oban.....	9.63	...	Carl.	Bagnalstown,Fenagh H.	.88	36
"	Poltalloch.....	6.87	179	"	Hacketstown Rectory...	.94	34
"	Inveraray Castle.....	15.12	238	Leiz.	Blandsfort House.....	1.48	56
"	Islay, Eallabus.....	3.45	90	Offaly.	Birr Castle.....	1.35	56
"	Mull, Benmore.....	16.40	155	Kild.	Straffan House	1.47	63
"	Tiree.....	4.30	128	Dublin	Dublin, Phoenix Park...	.85	44
Kinr.	Loch Leven Sluice....	1.29	43	"	Balbriggan, Ardgillan...	.68	34
Fife.	Leuchars Aerodrome...	.48	25	Meath.	Kells, Headfort.....	.71	26
Perth.	Loch Dhu.....	8.20	124	W.M.	Moate, Coolatore.....	1.18	...
"	Crief, Strathearn Hyd.	1.54	48	"	Mullingar, Belvedere...	1.57	58
"	Blair Castle Gardens...	1.51	58	Long.	Castle Forbes Gdns....	2.19	74
Angus.	Kettins School.....	.36	15	Gal.	Galway, Grammar Sch.	3.89	113
"	Pearsie House.....	.71	...	"	Ballynahinch Castle...	4.99	97
"	Montrose, Sunnyside...	.33	16	"	Ahascragh, Clonbrock.	2.41	72
Aber.	Balmoral Castle Gdns..	.47	16	Rosc.	Strokestown, C'node....	2.52	91
"	Logie Coldstone Sch...	.48	18	Mayo.	Black sod Point.....	3.35	82
"	Aberdeen Observatory.	.51	21	"	Mallaranny	4.42	...
"	New Deer School House	.99	38	"	Westport House.....	1.64	42
Moray.	Gordon Castle.....	.97	42	"	Delphi Lodge.....	9.57	115
"	Grantown-on-Spey .....	...		Sligo.	Markree Castle.....	2.32	67
Nairn.	Nairn	1.02	55	Cavan.	Crossdoney, Kevit Cas..	1.46	...
Iav's.	Ben Alder Lodge.....	7.38	...	Ferm.	Crom Castle.....	2.32	75
"	Kingussie, The Birches.	2.47	...	Arm.	Armagh Obsy.....	1.00	43
"	Loch Ness, Foyers	3.79	118	Down.	Fofanny Reservoir.....	2.14	...
"	Inverness, Culduthel R.	1.42	65	"	Seaford .....	.99	34
"	Loch Quoich, Loan....	50.03	...	"	Donaghadee, C. G. Stn.	.80	36
"	Glenquoich.....	32.02	329	Antr.	Belfast,Queen's Univ....	1.17	46
"	Arisaig House.....	10.35	221	"	Aldergrove Aerodrome.	1.21	48
"	Glenlevon, Corrour...	13.32	229	"	Ballymena, Harryville.	3.30	105
"	Fort William, Glasdrum	16.12	...	Lon.	Garvagh, Moneydig....	2.19	...
"	Skye, Dunvegan.....	9.68	...	"	Londonderry, Creggan.	2.61	82
"	Barra, Skallary.....	4.65	...	Tyr.	Omagh, Edenfel.....	2.33	74
R&C.	Tain, Ardlarach.....	1.12	45	Don.	Malin Head.....	2.33	81
"	Ullapool	7.44	178	"	Dunkineely.....	2.20	...

Climatological Table for the British Empire, October, 1937

STATIONS,	PRESSURE.		TEMPERATURE.						PRECIPITATION.						BRIGHT SUNSHINE.		
	Mean of Day M.S.L.,	Diff. from Normal.	Absolute.			Mean Values.			Mean, Max. 1/2 Min. Max. Diff. from Normal.	Mean, Wet Bulb.	Rela- tive Humid- ity.	Mean Cloud Am't.	Am't.	Dif. from Normal.	In.	Hours per day.	Per- cent- age of possi- ble.
			mb.	mb.	°F.	Max.	Min.	°F.									
London, Kew Obsy....	+ 1.0	67	37	58.3	46.6	52.5	+ 1.6	48.2	91	8.6	2.37	-	0.33	10	2.6	25	
Gibraltar	- 3.4	76	53	67.1	60.1	63.6	- 2.8	60.3	90	7.8	10.80	-	0.99	19	**	**	
Malta.....	+ 0.4	65	54	60.5	54.4	57.5	+ 0.0	55.3	93	10.0	1.87	+	0.56	14	**	58	
St. Helena	+ 1.4	71.4	77	67.5	71.4	74.5	- 0.6	66.0	77	6.0	1.88	-	0.99	5	6.6	**	
Freetown, Sierra Leone.....	+ 2.4	88	68	85.0	72.2	78.6	***	74.7	83	5.6	7.60	-	5.02	22	**	**	
Lagos, Nigeria	+ 1.1	87	71	81.4	79.5	79.5	- 0.2	75.4	87	8.2	5.45	-	2.32	16	5.7	48	
Kaduna, Nigeria	**	92	63	88.3	67.3	79.8	+ 1.5	75.1	86	7.9	2.39	-	0.46	8	7.5	63	
Zomba, Nyasaland	+ 1.7	91	54	82.9	61.7	72.3	- 1.8	68.7	79	3.5	1.32	-	0.20	2	**	**	
Sabahary, Rhodesia.....	+ 0.5	93	47	82.9	56.8	69.9	- 0.8	56.3	72	2.5	0.07	-	2	9.2	74	74	
Cape Town	+ 0.5	94	43	72.6	53.2	62.9	- 0.7	52.6	72	6.1	1.21	-	0.53	10	**	**	
Johannesburg	+ 1.2	86	40	75.7	52.4	64.1	+ 1.3	52.6	49	3.5	1.35	-	1.21	7	9.0	71	
Macau.....	- 0.1	85	59	79.9	64.9	72.4	- 0.3	64.2	85	5.6	2.14	+	0.47	14	8.8	70	
Talantia, Alipore Obsy.....	+ 0.8	91	67	88.1	74.4	81.3	+ 2.0	75.9	81	3.1	7.89	+	2.99	7*	**	**	
Bonaparte	0.0	92	72	88.7	76.0	82.3	- 0.1	75.9	85	1.7	1.77	-	0.10	3*	**	**	
Reference Madras	+ 0.4	94	71	87.4	75.0	82.0	- 1.1	76.6	86	6.7	10.40	-	0.75	14*	**	**	
Colombo, Ceylon	+ 1.2	87	72	85.0	75.2	80.1	- 0.4	77.0	78	6.3	9.67	-	3.69	19	7.8	65	
Singapore	+ 0.9	88	85.3	75.4	80.3	- 0.8	77.3	81	7.6	3.54	-	4.53	18	4.9	40		
Hongkong	+ 0.9	89	62	82.5	73.5	78.0	+ 1.1	71.2	85	3.7	1.50	-	3.44	8	8.6	75	
Sandakan	**	91	72	88.5	74.9	81.7	+ 0.3	77.4	83	8.6	11.55	+	1.22	18	**	**	
Sydney, N.S.W.....	+ 0.9	87	52	69.5	58.3	63.9	+ 0.3	59.0	65	7.5	3.31	+	0.46	17	5.4	42	
Melbourne	+ 1.5	84	44	68.4	50.6	55.5	+ 1.8	54.5	64	6.8	6.00	+	3.46	14	5.3	47	
Adelaide	+ 1.6	94	44	73.3	53.0	63.1	+ 1.2	55.5	62	6.2	0.54	-	1.20	8	6.7	52	
Perth, W. Australia	+ 0.6	91	45	71.5	53.5	62.5	+ 1.7	56.3	56	5.9	1.48	-	0.74	12	8.5	66	
Coolgardie	+ 0.6	100	41	80.8	53.8	67.3	+ 3.6	56.7	49	2.9	0.15	-	0.51	2	**	**	
Brisbane	**	75	38	63.0	48.0	55.5	+ 1.4	50.3	64	6.8	**	**	**	17	6.1	46	
Hobart, Tasmania	+ 5.8	75	38	58.7	44.4	51.5	- 2.9	48.9	69	5.5	0.94	-	3.14	7	8.2	62	
Wellington, N.Z.	+ 8.7	65	38	61.6	72.2	76.9	+ 1.1	72.6	81	7.3	6.63	-	1.66	21	4.6	37	
Suva, Fiji	+ 0.6	89	67	80.5	74.6	79.8	+ 1.4	76.7	76	5.3	9.28	+	2.90	18	6.6	53	
Apa, Samos	+ 1.1	87	71	87.8	73.6	80.7	+ 0.2	72.6	87	3.8	5.39	-	2.07	15	8.2	69	
Kingston, Jamaica	+ 0.3	92	71	87.8	73.6	80.7	- 0.1	74	75	4.	1.522	+	7.46	25	**	**	
Grenada, W.I.	+ 0.4	89	71	87	73	80	-	74.5	82	8.1	2.73	+	0.16	10	3.4	31	
Toronto	+ 1.6	78	28	63.8	41.2	47.5	-	47.5	83	8.1	0.71	-	0.66	8	3.2	30	
Winnipeg	+ 1.0	70	20	49.0	32.9	40.9	+ 0.2	34.7	80	7.5	0.71	-	0.18	16	4.2	38	
St. John, N.B.	+ 0.8	64	30	54.0	41.4	47.7	+ 2.4	43.4	82	6.4	4.72	+	0.54	13	4.9	45	
Victoria, B.C.	+ 0.3	68	42	60.1	47.4	53.7	+ 3.4	51.4	92	6.7	3.11	+	0.54	13	4.9	45	

